NOAA SECTORAL APPLICATIONS RESEARCH PROGRAM (SARP)
PROJECT FINAL REPORT

PROJECT TITLE

Pilot Studies to Evaluate Interpretation Methods, Intermediary Effectiveness, and Appropriate Levels of Intervention in the Provision of Climate Forecasts in the Sahel-Sudan: Climate Forecasting for Agricultural Resources (CFAR) Project-2

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I. PRELIMINARY MATERIALS

A. Project Abstract

The Sahel-Sudan region of Africa is one of the poorest areas of the world, whose economy depends mostly on rainfed crop and livestock agriculture. The region is an area that stands to benefit significantly from the appropriate application of climate forecast information to improve decisions affecting agricultural productivity and sustainability. Over the past decade, advances in climate models of international organizations have dramatically improved the skill of climate precipitation forecasts for broad regions of the Sahel-Sudan. The National Meteorological Services of individual countries have also developed forecasts for their specific agro-ecological zones.

Between 1998 and 2001 Tufts University and the University of Georgia carried out the Climate Forecasting for Agricultural Resources (CFAR-1) Project, a multidisciplinary project

with the goal of assessing how farmers (agriculturists and pastoralists) in Burkina Faso can use climate forecasts to enhance agricultural sustainability and food security. This first step in the research process consisted of basic ethnographic research on farmers' knowledge of climate variability and traditional forecasting indicators, farmers' information networks and flows, and farmers' decision making processes. This study generated several articles in scientific journals and conference presentations.

The research indicated that the greatest challenge to achieving benefits from climate forecasts is communicating the right information to farmers at the right time so that farmers can correctly interpret the forecast and apply it in their decision-making. This challenge was addressed in a second research project (CFAR-2), conducted between 2002 and 2007, which centered on the experimental dissemination of climate forecasts to farmers of 3 agro-ecological zones of Burkina Faso. The study was conducted in partnership with the Direction de la Météorologie (DMN) of Burkina Faso, and the Institut de l'Environnement et des Recherches Agricoles (INERA) and entailed a strong institutional capacity building component. Plan International, a development NGO, provided key logistic assistance and entry into some of the research communities.

The study addressed three major questions regarding the application of climate forecasts for improved livelihoods and sustainability of agricultural systems in the Sahel-Sudan: 1) How can we best explain scientific information to farmers ? 2) What additional information or resources must accompany a forecast, and how should such information and resources be made available to farmers? 3) What is the optimum role of intermediaries in forecast dissemination? .

B. Objective of Research Project

In order to answer the three research questions, the project focused on five **objectives**: 1) To develop methods that best explain and interpret forecasts for farmers; 2) To test different intervention strategies to assist farmers in developing improved methods to manage agricultural resources in response to climate forecasts; 3) To provide feedback to climate forecast and communication organizations on forecast needs; 4) To implement newly developed forecast products as appropriate for farm-level use; 5) To integrate and coordinate with other programs related to improving agriculture in the Sahel-Sudan.

C. Approach

The participatory approach adopted during CFAR-1 fostered a climate of trust and commitment among research communities and partner institutions. Involvement of users in the production and dissemination of climate applications helps ensure relevance of information content and appropriateness of communication formats and channels. It facilitates a better understanding of the process and, therefore, the potentials and limitations of climate forecasting among users and a higher level of accountability and appreciation of users' vulnerability to climate risk among scientists. It also fosters local ownership and builds trust between producers and users of climate forecasts, which is essential for turning the inevitable failures into opportunities for learning.

During the second phase of the project (CFAR-2), we continued operating according to principles of participatory research, involving local communities and relevant stakeholders. The research followed a multidisciplinary approach, including anthropology, agronomy, agro-climatology, crop modeling, water resources, and veterinary sciences. The project was informed by a strong commitment

to collaborative research, expressed in the designing and implementing of project activities and development of data analyses and publications in consultation with partners institutions in Burkina Faso. We consistently sought and seized opportunities to enhance their institutional capacity.

The research focused on farming communities, including agriculturalists and pastoralists, in the three main agro-ecological zones of Burkina Faso, which represent three distinct livelihood systems: 1) agro-pastoralism in the Sahel; 2) subsistence grain farming in the Central Plateau, and 3) commercial cotton production in the Southwest. In each zone we selected three villages. The three villages of each zone had largely similar livelihood systems but varied in terms of topography, hydrology, soils, demographic and ethnic composition, leadership patterns, political unity, exposure to development interventions, and access to roads and markets.

In each zone, the three villages were to be involved in ways that represented different levels of forecast intervention: a) Level 1: forecast to be disseminated through radio broadcasting, extension services, and spontaneous word-of-mouth exchanges; b) Level 2: forecast to be disseminated through a workshop, in addition to being exposed to radio broadcasts, extension services, and word-of-mouth; c) Level 3: same as Level 2 villages, but will also have access to trained intermediaries who attend the workshop and who will have access to technical backstopping from the agronomists and livestock experts of the CFAR team and its partners. This research design was eventually modified in response to the contingent conditions as explained in Section II.D (Deviations from Plan). The methodological approach is elaborated in Section II.A1 (Field Activities).

Research with farmers was guided by several principles: a) an understanding that rural production and livelihood system are highly diversified, which requires the integration of a wide range of environmental, economic, social, and cultural variables; b) an appreciation that farmers' decisions are very complex and are influenced by past experience, assessment of immediate environmental conditions, perception of available options, and household risk tolerance thresholds; c) a recognition that farmers can best assess their own risk tolerance levels and know how to manage climate risk, and that they should be allowed to make their own production decisions, including those made in response to forecasts, and whether they raise or lower their risk exposure; d) an emphasis on adaptive technologies and techniques that are already in place or procurable in country and sustainable in the long run; and e) climate information is only one element in a wide repertoire of resources and strategies farmers may use to manage climate risk.

C. Description of Matching Funds/Activities Used in Project

$26,000 for the CFAR Stakeholder Workshop was contributed by USAID Office for Disaster Assistance (through an inter-agency agreement with the National Weather Service).

Approximately $60,000 was provided by the Fulbright Program to support Dr. Moussa Sanon's nine months fellowship to work with Dr. Hoogenboom at the University of Georgia.

Indirect financial support was provided by the University of Georgia in the form of salary and benefits for the contributions of Dr. Hoogenboom.

II. ACCOMPLISHMENTS

A. Brief discussion of project timeline and tasks accomplished.

1. Field activities. With research activities spanning over several years (1998 to 2007), the CFAR project had the unique advantage of developing a strong rapport with institutional

partners and local communities. In each zone, project activities were coordinated by a local facilitator (retired extension agents), who was well known and respected by farmers. The facilitators ensured a constant and visible presence of the project in the communities and enabled a two-way communication between farmers and scientists.

Following a rolling design, the project included three communities in each zone, starting with one village per zone, where we had worked during the first phase of the project, and adding two additional villages per zone, one in 2002 and one in 2003. In each village, the project established 6-7 contact farmers, who managed a rain gauge and four test plots located in their fields, to provide data on actual rainfall and production outcomes. The data were collected regularly by the facilitators and copies were mailed to the research team and to the Burkinabé partner institutions.

The CFAR approach to forecast dissemination hinged on participatory workshops. Two sets of workshops were held in June of 2002 and of 2003, immediately after PRESAO, as soon as the seasonal rainfall forecasts for Burkina Faso was released. The 2002 workshops were held in the provincial capitals (Houndé, Boulsa, and Dori) to facilitate attendance by government level officials and technical services as to ensure their support from the project's onset. In 2003, workshops were moved to the village level to reduce travel time and to accommodate farmers' preference for a more familiar setting. Extension and development agents, government officials, and traditional authorities, and 12-14 farmers from each village participated in the workshops. They were selected by the facilitators, in concert with community leaders. Because workshop participants were called upon to pass the information to other residents in their communities, the selection aimed at individuals who were socially positioned to do so. However, additional efforts were made to include minority groups, such as pastoralists and immigrants, as well as some women.

The workshop programs unfolded in two parts. The first part of the workshop aimed to facilitate farmers' understanding of scientific forecasts. It began with a presentation on how forecasts are produced, explaining their limitations of scale and timeframe. Then facilitators elicited farmers' own predictions for the upcoming season and opinions about the accuracy of such predictions in the previous year. This part included various practical examples and exercises to explain probability. The second part of the workshops included a discussion of potential application of the forecasts to crop and livestock management decisions. Finally, participants gathered in small groups to devise a dissemination strategy for their villages. In addition to dissemination by workshop participants, announcements summarizing the forecasts were broadcast on FM radio stations in local languages. The script for the radio announcement was also printed on flyers, which were given to workshop participants to help them remember the information. In late July, forecasts updates were broadcast by local radios and also printed on flyers.

In March 2003 and in June 2004, the project team returned to the field and carried out semi-structured interviews with farmers in the three villages of each zone to follow up on recollections and responses to the 2002 and 2003 forecasts. Respondents were interviewed in their native language, with one the CFAR facilitators translating. They were asked whether they received any forecast information (either at the workshop or by other means); and, if they had, what did they understand; whether they shared the forecasts with others; whether and if so how they used the forecasts in making production decisions; and how they felt about the forecasts. The two survey samples included approximately 160 farmers each (including farmers who had participated and farmers who had not participated in the workshop). Given that workshop

participants and survey respondents were selected from among household heads, most (94%) of them were men, but interactions with women during fieldwork allowed the team to learn about women's experiences with the forecasts.

The methodology had two limitations: a) the interviewing team was composed of the same researchers and facilitators who organized the workshop, which might have biased farmers towards providing positive assessment of the forecasts; and b) samples were constructed purposely rather than randomly, due to the difficulties of mobilizing farmers for interviews during planting time. These limitations were addressed by asking different questions on the same issue to cross-references farmers' answers and by ensuring that samples comprised farmers from all social groups and *quartiers* that constituted each village. The project's long-term involvement with local communities and presence of facilitators in the field sites also enabled on-going data triangulation and monitoring of producers decisions, livelihood impacts, and community dynamics. The survey data sets are complemented and contextualized by many interviews with resource persons, community leaders, extension agents, government officials, as well as by participant observation during the extended fieldwork periods. All interview fieldnotes have been transcribed, coded, and analyzed in Excel.

2. Decision Support Systems. In June 2002, raingages and thermometers were installed in selected fields of participating farmers by teams composed of CFAR, DMN, and farmers. In total, 54 raingages (6 raingages in each of 3 villages in each of the 3 zones) and nine thermometers were installed and farmers trained to read them. A total of 216 microplots (4 in each field that hosts a raingage) were also established for observation of farmers response strategies and yield outcomes. Upon request of some of the farmers in the field sites, a few more raingages were added in June 2003 to ensure a more equitable and inclusive coverage of all village sections (*quartiers*). All materials used by the project (rain gauges in farmers' fields and blackboards for posting climate information) were left in the communities for the farmers' use at the end of the data collection. As of June 2007, there is evidence that some of the farmers have continued to collect rainfall information for their own use.

For the application of the Decision Support System for Agrotechnology Transfer (DSSAT), INERA's agronomist Dr. Moussa Sanon conducted two planting date trials with several millet and sorghum cultivars at a Burkinabe research station in Di in 2004 and 2005. The main goal of this experiment was to obtain detailed phonological and growth information to help determine the cultivar coefficients for the crop simulation models. Dr. Sanon also collected 9 soil samples in each of the villages, which were later analyzed by INERA. Initial evaluation of the models showed that the local sorghum and millet varieties are extremely sensitive to photoperiod and have some growth habits that are somewhat different from varieties that have been bred for high yield. Goals of Dr. Sanon's Fulbright study were to improve the crop models and DSSAT for applications both locally in Burkina Faso as well as regionally in West Africa and to include yield forecasting based on climate forecasts.

In an effort to better understand the role of the irrigation barrage in Bonam in the Central Plateau on crop production, elevation changes, releases, rainfall, and temperature were collected there. Irrigation practices were also collected from interviews with some key farmers. The research resulted in a computer based mathematical programming model that a farmer or advisor to farmers could use to provide information on what crops to plant when, where, and how given the seasonal climate forecast (see Education Section).

3. Institutional capacity building. The project has had a sustained commitment and substantial accomplishments in building institutional capacity in Burkina Faso, in West Africa, and in the US.

a) The project has stimulated awareness of climate forecasts in Burkina Faso, including local communities and provincial level stakeholders who participated in the 2002 and 2003 forecast dissemination workshops and in the research activities. Responding to the widespread demand for forecasts in the CFAR sites, arrangements were made for disseminating forecast in 2004 and 2005 as well through the CFAR facilitators and the contact farmers as well as by radio broadcast and local language flyers. An open channel of communication remains active between the facilitators and the DMN that has enabled communities to seek climate information, but we are working toward institutionalizing climate forecasts dissemination in those areas. This process has culminated in a Stakeholder Workshop held in June 12-13, 2007. Obtaining funding and planning for the workshop has provided a valuable learning opportunity for the partner institutions. The workshop proceedings provide valuable resource material to help local organizations network among themselves, access information, and organize similar events. See Section V. for a more detailed description of the workshop.

b) The project has systematically provided opportunities for partner institutions (INERA and DMN) to collaborate together, carry out farmer-centered research, facilitate participatory workshops, etc. In so doing, the project has strongly promoted participatory, collaborative approaches and provided incentives for national level institutions to integrate farmers' concerns and priorities in their research agenda (this is a notable advance, given that the country's prevailing trend of top-down research and development efforts). Relevant literature and necessary equipment have been provided to the partner institutions. Younger scientists from the partner institutions have been trained and mentored by the CFAR team in a wide range of skills and methods, including ethnographic research, qualitative methods, data analysis, crop modeling, grant proposal writing, and preparing manuscripts for publications and presentations for professional conferences.

c) The project provided resources and technical assistance for two visiting fellowships at the Department of Biological and Agricultural Engineering of the University of Georgia in the Spring semesters 2002 and 2003. The fellowships enabled one scientist from each partner institution (INERA and DMN) to spent four-months training on DSSAT modeling and agro-meteorology under the direction of Dr. Hoogenboom. The scientists utilized data collected by the CFAR project (including the village level raingages, microplots, soil samples, and socioeconomic surveys) to calibrate the DSSAT crop simulation models for the major staple cereals produced in the three zones (maize, millet, sorghum). As a result of that, INERA scientist Dr. Moussa Sanon was subsequently awarded a Fulbright Fellowship to further enhance his skills on crop modeling and decision support systems. Between November 2006 and November 2007, Dr. Moussa Sanon will continue research in crop modeling and its applications in Burkina Faso at the University of Georgia. He will also visit Tufts University, attend the Annual Meetings of the American Society of Agronomy, and of the African Studies Association, and be exposed to relevant projects, such as the Southeast Climate Consortium RISA.

d) The project has also provided technical advice and input to regional and global institutions and projects on the communication of climate information to rural communities. Research findings, relevant literature, and feedback on papers, proposals, and planning have been provided to scientists from these organizations. C. Roncoli has provided technical expertise to ACMAD and to other African Met Services (e.g. Uganda, Kenya, Senegal, Mali). G.

Hoogenboom is currently a member and Vice-Chair of the Scientific and Advisory Council of the Centre Regional de Agrhymet. Agrhymet plays a key role in disseminating weather and climate forecasts to its member countries in Sub Saharan Africa, including Burkina Faso. C. Roncoli was a keynote speaker during a workshop on Applications of Climate Predictions in Agriculture organized by the CLIMAG project of START, in collaboration with IRI and WMO and held in Geneva, Switzerland in May 2005. She has also been a member of a review panel for IDRC's Climate Change Adaptation in Africa program. C. Jost has transferred CFAR's participatory approach to epidemiological research at ILRI. G. Hoogenboom has participated in three training workshops in West and East Africa, sponsored by ICRISAT and TSBF-CIAT, which included scientists from INERA, Burkina, as well as other organizations

e) Finally, the long-term continuity of community-based research afforded by the NOAA grants has enabled the research team, not only to gain a rich understanding of the context, but also to develop deep personal relationships in those communities. Having been generously hosted and embraced by local families, we have felt compelled to reciprocate as best as we could, using our personal time and resources. For example, members of the CFAR team (Roncoli and Jost) have helped a women's cooperative in one of the field sites to obtain several years of funding for literacy training and micro-credit activities from the NGO Global Fund for Women. This has helped 50+ formerly illiterate women to become literate, and about 20 have become literacy trainers and supervisors and are now are training more than 500 women per year. C. Jost and two of her graduate students in veterinary science provided the same cooperative with training in animal health to help them establish a profitable livestock-based income-generation scheme.

4. Education. In April 2005, Melvin Rader (Tufts University) completed an MS thesis in Civil and Environmental Engineering on "Incorporating Risk into a Decision Support System for Burkina Faso Farmers" under the direction of P. Kirshen. The research resulted in a computer based mathematical programming model that a farmer or advisor to farmers could use to provide information on what crops to plant when, where, and how given the seasonal climate forecast. It was shown to give reasonable results when its recommendations were compared to our field data. A journal article is now under review.

In August 2006, Colin West (University of Arizona) successfully defended his a PhD thesis, based on his research in Burkina Faso. Colin worked under the supervision of C. Roncoli, and benefited from the institutional support and technical assistance of the CFAR project in Burkina Faso and during dissertation write-up. Colin's research focused on applications of agent-based modeling to the study of household adaptation to climate change, particularly the role of household communal fields and inter-household grain sharing arrangements. Colin is currently serving as a NOAA post-doc at the University of Alaska, Anchorage.

B. Summary of Findings

These are based primarily upon the results of the 2003 forecast survey, which was the most complete survey.

1. Accessing forecasts. Despite the project's efforts to ensure inclusiveness, the selection of research and workshop participants could not avoid getting entangled in local social dynamics, with efforts by prominent groups to exclude marginalized sectors of society. These included:

women, pastoralists, immigrants, lower castes, political opponents, and contestants in territorial disputes. Nonetheless, the range of dissemination strategies deployed by the project and by workshop participants resulted in the forecast reaching a considerable proportion of the farmers who did not participate in the dissemination workshops. Overall, 38% of the farmers who did not participate in the workshop and 48% of those who did participate heard a radio program about the forecasts. Mention of radio broadcasts varied considerably among sites according to variation in coverage ranging from 20% of all respondents in the Central Plateau to 62% in the Southwest.

Workshop participants had committed to share the forecasts with their communities, and most did so by organizing meetings at the village or *quartier* level: 69% of the workshop participants took part in such meetings, the rest being impeded by travel, illness, or other business. Yet community meetings were not more effective than word of mouth in disseminating the forecasts; both methods reached about one-fifth of the farmers interviewed. Over half of the workshop participants and 80% of non participants who had received the forecasts reported sharing the information with family, friends, and neighbors. This difference between the two groups may be due to the fact that workshop participants might have reported organized meetings as the way they shared the information, neglecting to mention informal interactions.

About 32% of workshop participants reported disseminating the forecasts at social occasions. Some participants shared the forecasts during various committee meetings at the village level, and a village *delegué* (government-appointed village representative) reported it to *delegués* of other villages at a provincial level meeting. Mosques were frequent sites of meetings or word-of-mouth communication, particularly in the Sahel, where most of the population is Muslim. Sharing information at (Christian or Muslim) prayer meetings was also mentioned by some of the women interviewed. Women also discussed the forecasts when they gathered at water fountains and on the road, as they walked to markets. Some (12%) of farmers who did not participate in the workshop reported hearing the forecasts at such social gatherings. On the other hand, few extension agents reached few farmers, which is not surprising given the dearth of resources that hampers government services. A few farmers in the Southwest reported getting the forecasts from a cotton agribusiness, but in these cases the company agents disseminated information from SOFITEX rather than the forecast presented at the workshop.

Given that workshop participants committed to sharing the forecast with their communities, it is not surprising that most reported doing so. However, many of the farmers who did not participate in the workshops also did so. The few who did not share the forecast with others justified their decision based on the fact that they had not received the information first hand (at the workshop) and therefore they were not sure they could report it correctly or answer questions about it. In fact, those who did report the forecasts to others fielded a number of questions, including how certain was forecasts, how was it produced, whether it was specifically for their villages, what farmers should do to adapt, and whether the project would provide help.

2. Understanding forecasts**.** Many farmers related to the discussion of local indicators, which meant to reinforce the notion that predictions may not always coincide with outcomes. These efforts helped to ensure that 80% of workshop participants, compared with 30% of the farmers who did not attend the workshops, retained some notion of the probabilistic nature of the forecast. Comprehension of probability ranged from basic reference to uncertainty to a detailed account of probability distribution presented at the workshop. Vague allusions to uncertainty (e.g. “there is a chance,” “it is possible that,” “did not say it was not for sure”) were more commonly reported by farmers who did not participate in the workshop. A more sophisticated

understanding that, while multiple scenarios were possible, some were more likely than others was reported by 48% of the workshop participants, but also by 36% of non-participants. More than one-fourth of respondents interpreted probability in terms of spatial variability. A few reported technical information suggesting that farmers should prepare for different rainfall scenarios.

Workshop presentations also sought to clarify the limitations of the forecasts, in terms of its temporal frame, spatial scale, and parameters. More than half of the farmers who attended the workshop, but only 11% of those who did not, retained some of these explanations. These respondents understood that the forecasts cover only certain months, but did not always remember which months, that they cannot predict how much it would rain in any given month, or whether there would be dry spells, or when the rains would end, or which villages would receive rain. Because previous research had shown that farmers tend to interpret climate forecasts in terms of duration rather than amount of the rain, much effort was devoted during the workshop to emphasizing that meteorologists cannot predict the timing of the onset and end of the rains. Interviews showed that such efforts were successful, as only 18% of respondents believed that the forecasts predicted how long it would rain and when rains would end. Some farmers (10%), especially those that did not attend the workshop, interpreted the forecasts in terms of rainfall distribution. A few (7%) of them recalled a prediction for good yields or food security rather than rainfall patterns per se. Overall, the large majority of farmers retained something about the nature of the season.

Management strategies discussed during the workshop were almost as salient as climate information in farmers' recollections, possibly because it fit with their expectations of what a meeting organized by extension agents and foreign researchers would be about. Technical information was recalled by 58% of the workshop participants and 30% of non-participants. It related to crop and livestock management practices, such as choices of fields, crops, and varieties, techniques to channel or retain water, to conserve or restore soil fertility, and to prevent erosion, and efforts to protect animals from dangers and diseases brought about by excessive humidity. In some cases, these discussions translated into management changes, in others they did not, for reasons that are explored below.

3. Responding to forecasts. Demonstrating a direct linkage between climate forecasts and changes in management practices remains a challenge, as production decisions by African farmers are shaped by many environmental, agronomic, and economic factors beyond climate information. These decisions are made up of small, sequential adaptations to shifting conditions rather than a single deliberation. Because seasonal rainfall forecasts for the region are not issued until late May-early June, some farmers had started planting at the time of the workshops, especially the sandy fields in the Sahel, the lowland fields in the Central Plateau, and cotton (and some maize) in the Southwest. Thus, the forecasts were introduced into a planting process that extends over several weeks, prompting farmers to confirm or revise their strategies. In affecting management strategies, the forecasts interacted with farmers' own observations, experiences, and predictions.

Given the delay in the onset of the rainy season in 2003, most farmers in all three zones were preparing for an unfavorable season. In some cases, respondents reported that traditional indicators had forecast good rains, but the delayed onset had made them doubt such predictions. These farmers were planning to abandon their upland fields and longer duration crops and varieties, and shift to shorter duration crops and crop varieties, particularly if the crops they had

planted failed to get established. Because farmers were already attuned to the possibility of drought, very few of them reported shifting strategy to plan for the 30% probability of below normal poor rainfall. Rather, in interpreting and applying the forecasts, farmers focused on the auspicious prospect that the season could still turn out to be good, paying less attention to the low probability scenario. They were especially inclined to take this possibility seriously if it rained during or shortly after the workshop or if, around that time, they observed good crop establishment, replenished water sources, or widespread pasture growth. Most farmers who reported making forecast-based changes in their management decisions did so in preparation for good or heavy rains, although not entirely abandoning drought preparedness options.

Although it is prudent to assume that the climate forecasts were only one and by no means the only factor that shaped farmers' decisions, field data suggest that they played a salient role. Choices of what, when, and where to plant are closely related, so it is sometimes difficult to separate forecast responses into discrete options. However, there is some evidence that workshop participants enacted a wider repertoire of responses than farmers who had not attended. The latter were more likely to respond to the forecast by one strategy (e.g. choosing a different variety or adding a new field), whereas workshop participants were more likely to report two or three strategies, an outcome that was possibly influenced by discussions of technical information during the workshop.

The most common response to the forecasts was to adjust the choice of field type and area planted, which was reported by 61% of workshop participants and 50% of non-participants, based on their assessments of how well different soil conditions and topographic locations suited the expected rainfall scenario. Expecting average or good rains, farmers enlarged their existing fields from a fraction to several hectares by planting areas they had left unplanted prior to the workshop. Some farmers chose to diversify their holdings by adding upland fields or by planting the elevated borders of a lowland field. Others sought to reduce potential losses, by abandoning lowland fields that were prone to flooding.

Adjustments of field type and size were closely linked with the selection of crops and crop varieties. Changes in crops and varieties were reported by 51% of the workshop participants and 35% of non-participants. Farmers chose to expand cultivation to areas suited to certain crops and decided to plant specific crops in order to exploit additional land. For example, the expectation of good rains gave Sahelian farmers confidence to plant clayey fields, which produce well in such conditions.

Efforts to expand or diversify cropping systems led some farmers to make choices about land management, reported by 21% of workshop participants and 13% of non-participants. To reclaim marginal or depleted fields, farmers adopted or expanded the implementation of soil and water conservation practices (e.g. '*zai*', stone barriers, grass hedges, and mulching) and applied various soil amendments. Some farmers intensified land preparation to facilitate water infiltration. Southwest farmers altered ridge orientation according to whether they wanted water to stay or flow, so they could plant certain areas with rice or maize. In some cases, farmers adjusted the timing of input application and plowed fertilizer into the soil to avoid leaching during heavy mid-season rains.

Although most livestock management decisions tend to follow rather than anticipate the rains and animals can move to where water and pastures are available, 42% of workshop participants and 33% of non-participants reported altering husbandry practices. Most commonly, farmers decided move cattle corrals to higher ground and a few built shelters for small ruminants and poultry to prevent the diseases that occur in humid terrain. Other actions were also taken.

Only 24% of farmers who did not attend the workshop and 10% of those who did not reported that they did not use the forecast information. Most of these farmers complained that they had received it too late or that they were impeded by production constraints: for example, some farmers would have liked to expand their fields but could not do so because they did not have suitable land or were unable to obtain or borrow more land. The ambiguity of the forecasts also deterred some farmers from using it, because it did not indicate any one scenario (above, near, below average) as much more likely than the others. These explanations are significant because they highlight key impediments and interactions (e.g. the role of family labor, livestock movements, and off-farm income) that shape farmers' willingness and ability to use climate information.

4. Evaluating forecasts. Given that farmers' uses of the forecasts were modest adjustments that blended into the configuration of tactical decisions made as the season unfolded, a quantitative impact assessment of forecasts responses is very difficult to implement. Therefore, rather than estimating the impacts in terms of production output, the study elicited farmers' subjective evaluations of the accuracy and the usefulness of the forecasts. In many cases, the respondents who had received the forecasts volunteered comments on what they thought of the forecasts. When they did not, they were asked to do so. Most farmers who had made decisions based on the forecasts were extremely satisfied with the results. Their positive assessments of the forecasts might have been biased by two factors: a) farmers might have been reluctant to criticize information brought by a team of government and expatriate researchers, introduced by extension workers or village authorities; and b) farmers were delighted with the fact that, despite their delayed onset, the rains had been favorable and had fallen regularly and long enough to bring most crops to maturation.

Given that their interpretation of the forecast was for 'good' or 'a lot of' rain, 94% of farmers assessed the forecast as having been accurate and requested that seasonal forecasts be delivered to them on regular basis. In justifying their assessment, 42% of the farmers mentioned rainfall patterns, but they were not, in fact, part of the forecasts. Some farmers noted that the forecasts had been accurate for their own areas but not for others nearby, which had not received sufficient rains, an observation that was consistent with their understanding of probability in terms of spatial variability. Yields were equally important criteria, also mentioned by 33% of the farmers, who commented that crops (beans, peanut, rice) and pastures did well. A few farmers explained their evaluation in terms of food security: their granaries were full, their households had enough to eat for the rest of the year, and nobody was forced to buy food in the market. A minority of farmers found the forecasts to be inaccurate because it rained more than expected or because it rained elsewhere but not in their village.

Most farmers judged the forecasts to be useful, with 55% responding that they appreciated the forecasts for their instrumental value, namely, that the forecasts helped them be prepared, make decisions, adjust strategies, and prevent losses. Some farmers suggested ways of enhancing the utility of the forecasts, namely by delivering them earlier and by complementing them with technical advice and provision of inputs. Pastoralists also recommended producing forecasts that are more relevant to livestock management decisions.

Besides utilitarian considerations, a notable proportion of farmers mentioned less tangible gains. They included cognitive benefits (the opportunity to expand their knowledge): about 22% of respondents appreciated "adding to what they know," "learning something new," and "being exposed to new ideas," Among non-material gains, farmers also mentioned affective or

emotional considerations, such as feeling less anxious about the season ahead. These were mentioned by 19% of respondents, but the proportion doubles if one includes other spontaneous statements made in the course of the interview. These emotional benefits are noteworthy, particularly at a time, such as the onset of the rainy season, when farmers need to work hard in very harsh conditions, investing energies and resources towards uncertain production outcomes.

5. Conclusions. Our findings that participatory workshops help farmers to better understand and use seasonal climate forecasts are similar to other researchers. Interviews with farmers who had attended workshops and farmers who had not attended revealed that the former were more likely to share the information with others, to understand the probabilistic aspect of the forecasts and their limitations, to use the forecast in making management decisions by a wider range of responses, and to evaluate the information more positively in terms of both material and non-material considerations.

We also found that the use of visuals and exercises during workshops may enable participants to relate forecast information to everyday life. Question and answer sessions may be more consistent with traditional learning styles, which privilege oral forms of knowledge transmission. Discussions among participants may encourage the integration of new scientific information with local knowledge relative to farming and forecasting. Group interaction may encourage the experiential processing of information, by pooling the know-how of participants that have different levels of competence and exposure. Farmer-centered research eliciting farmers' perceptions and experience may sustain scientist-stakeholder communication and community participation beyond the workshops.

Continuity of interaction with farmers helped the project win the support of local authorities and community leaders and develop relationships with dynamic and influential contact farmers who spearheaded forecast dissemination in each village. The project was also able to identify and retain local facilitators, who had lived and worked in those villages for many years and were highly trusted by farmers. These facilitators were able to monitor farmers' activities, answer questions when needed, and maintain contacts between farmers and scientists in between research trips. Several farmers commented that they were willing to take the forecasts seriously and help with their dissemination because they knew the scientists would come back to see what happened and to help them understand and explain possible failures. They also appreciated having an unprecedented degree of direct access to national level researchers and agencies through the facilitators.

Trends and forces that operate in the broader context of state and society may favor or hinder participation in climate forecast dissemination as well as in other instances of technology transfer. In its pursuit of stakeholder involvement, the CFAR project was aided by the prevailing emphasis on participatory approaches in current government policy and development practice in Burkina Faso. The project team was able to appeal to such principles in advocating for inclusion of marginal social groups and in promoting a two-way dialogue between rural communities and national institutions. Nonetheless dissemination efforts were sometimes thwarted by long-standing ethnic tensions and social conflicts that operated at the local level. This shows how scientific information, such as climate forecasts, is more than a technical input. Rather, it intervened as dynamic elements in a field of power relations in which social identities and boundaries are negotiated through various degrees of access and ability to use it. It is therefore essential that climate application efforts, such as collaborative production or participatory

communication of climate forecasts, be grounded in a thorough analysis of the diversity of actors, the dynamics between them, and their different stakes in the process.

6. Implication of findings

On forecast dissemination

- Disseminating climate information should take advantage of the wide diversity of media that can reach rural communities: these include radio programs and printed matter in local languages, extension and development agents (where they are operational), but also informal channel through interpersonal exchange, public space interactions, community events, producer organizations, etc.
- Participatory workshops at local level are extremely effective in conveying forecast information, explaining probability and forecast limits, and helping farmers formulate response strategies. However organizing and implementing workshop requires considerable human and financial resources that are not available to African national meteorological services. It is conceivable, however, that, with adequate external support, provincial workshops (each covering 3-4 of the 45 provinces in the country) can be implemented at the onset of the season. Such workshops can and must be used to disseminate not only seasonal rainfall forecasts but also to demonstrate 'best practices' in agriculture and natural resource management.
- However, it is important to recognize that participation is not a panacea, and even 'participatory processes' can be ridden with tensions and conflicts. The organization and implementation of 'participatory' information dissemination processes should be done carefully and be mediated by respected, impartial individuals who do not represent the interests of particular groups or factions. In particular, there should be an explicit policy of recognition of the rights of minority and marginal groups, such as women, immigrants, pastoralists, etc.
- Because some adaptive responses entail supra-local decisions and impacts across the landscape, participatory dissemination approaches should also allow for consultations and negotiations among the representatives of the relevant territorial and administrative units, including the traditional leaders as well as elected representatives of decentralized collectivities (rural Commune councils)
- Dissemination of climate information should be complemented by adequate policies and programs that support farmers' ability and flexibility to enact adaptive strategies: such interventions should not be prescriptive of specific technologies or tied to specific agricultural commodities: rather they should propose a 'basket' of widely applicable options and enable farmers to understand, select, and adapt what best fits their conditions and priorities.
- Effective climate application programs require commitment to and investments in capacity building at all levels. Locally, efforts to improve rural literacy will enhance farmers' ability to understand and retain climate information; technical training in crop and livestock management will increase farmers' options and promote sustainable household adaptations. At provincial level, periodic information sessions and distribution of resource materials towards technical services, government administrators, elected officials, and NGOs would enable them to better serve as intermediaries.

- At the national level, opportunities to improve the capacity of policy makers, agribusiness, and the media to understand and integrate climate forecasts in their decisions and messages are also needed. A process of stakeholder consultation, perhaps under the guidance of the national meteorological service or other authoritative body, should be established to ensure consistency of messages and prevent the proliferation of contradicting or misleading messages.

On decision support systems (DSS):

- It is possible to develop DSS tools, such as crop simulation models for predicting production outcomes and an optimization model for crop scheduling, and such tools can enhance the value of forecast.
- DSS tools can serve to facilitate learning (to help farmers envision outcomes of different response strategies) and to stimulate discussion in participatory workshops (to help users devise and discuss alternative strategies).
- DSS tools needs to be carefully calibrated for local conditions and tested against real life scenarios, but implementing and evaluating the impacts of such tools require considerable resources.
- Data collection by farmers can increase understanding and involvement by local communities, but the quality and consistency of the data generated may fall short of the quantity and standards that such tools demand, and must be complemented with more rigorously collected data. Therefore institutional capacity building for national research institutions is an extremely important component of a DSS approach.

C. List of any reports, papers, publications or presentations arising from this project

Refereed Journal Articles

Roncoli, C., C. Jost, P. Kirshen, G. Hoogenboom, K. Ingram, M. Sanon, L. Somé, J. Sanfo, F. Ouattara, C. Sia. 2007. "From Accessing to Assessing Forecasts: an End-to-End Study of Participatory Forecast Dissemination in Burkina Faso (West Africa)." Climatic Change (submitted June 2007).

Rader, M., and Kirshen, P. 2006. "A Decision Support System for Resource Poor Farmers in Burkina Faso", Journal of Water Resources Planning and Management (submitted December 2006).

West, C., C. Roncoli, F. Ouattara. 2007. "Local Perceptions and Regional Rainfall Trends in the Central Plateau, Burkina Faso." Land Degradation and Development (accepted August 2007).

Roncoli C. 2006. "Ethnographic and Participatory Approaches to Research on Farmers' Responses to Climate Predictions." Climate Research, 33, pp. 81-99.

Chapters in Books

Roncoli, C., K. Ingram., P. Kirshen, and C. Jost. 2004. "Integrating Indigenous and Scientific Rainfall Forecasting'. In: Indigenous Knowledge: Local Pathways to Global Development. The World Bank, Washington DC, pp. 197-200.

Roncoli, C., Ingram, K., P. Kirshen, and C. Jost. 2003. "Meteorological Meanings: Understandings of Seasonal Rainfall Forecasts by Farmers of Burkina Faso." In: S. Strauss and B. Orlove eds. Weather, Climate, and Culture, Berg, New York, pp. 181-202.

Works in Preparation

Roncoli, C., C. Jost, P. Kirshen, G. Hoogenboom, K. Ingram, M. Sanon, L. Somé, J. Sanfo, F. Ouattara, C. Sia. "Knowledge Encounters: Participatory Workshops as Avenues of Dissemination of Climate Forecasts in Burkina Faso". Science, Technology, and Human Values (Projected submission date is October 2007).

Roncoli, C., M. Sanon, L. Somé, C. Jost, G. Hoogenboom, P. Kirshen. "Modalité de Communication des Prévisions Saisonnières et Stratégies de Production Agricole dans 3 Zones Agro-climatiques du Burkina Faso.'' Sécheresse (Projected submission date is Sept 2007).

Jost, C., C. Roncoli, G. Hoogenboom, P. Kirshen, M. Sanon, L. Somé. "The Role of Climate Forecast in Pastoralists' Adaptations to Climate Variability in the Sahel" Human Ecology (Projected submission date is November 2007).

Technical and Workshop Reports

Roncoli C., M. Sanon, A.J. Garané, A. Diallo, L. Somé. 2007. Rapport de l'Atelier sur la Communication de l'Information Climatique aux Communautés Rurales dans l'Afrique de l'Ouest, à Ouagadougou, Burkina Faso le 12 et 13 Juin, 2007. Direction de la Météorologie et Projet CFAR, Ouagadougou, Burkina Faso.

Presentations Made at International, National, and Regional Conferences

Roncoli, C., L. Some, M. Sanon, C. Jost, P. Kirshen, G. Hoogenboom. 2007. Communication et Utilisation des Prévisions Saisonnières dans 3 Zones du Burkina Faso. Paper presented at a Stakeholder Workshop on Communication of Climate Information to Rural Communities, Ouagadougou, Burkina Faso, June 12-13, 2007.

Sanon, M., G. Hoogenboom, C. Roncoli, J. Paz, A. Garcia y Garcia. 2007. Outils d'Aide à la Prise de Décision dans la Gestion des Ressources Agricoles et Naturelles. Paper presented at a Stakeholder Workshop on Communication of Climate Information to Rural Communities, Ouagadougou, Burkina Faso, June 12-13, 2007.

Kirshen, P., Jost, C., Roncoli, M.C., Hoogenboom, G. 2006. Opportunities and Challenges in Using Hydrologic Information and Decision Support Tools to Improve Livelihoods in Burkina Faso, West Africa. Invited Paper, American Geophysical Union, Fall Meeting, 11-15 December 2006.

Roncoli, C. 2005. Pursuing the Bird of the Forest: Lessons in Ethnographic and Participatory Research on Farmers' Responses to Climate Predictions. Invited keynote paper presented at the International Workshop on Climate Predictions and Agriculture, IRI/START/WMO, Geneva, Switzerland, May 11-13, 2005.

Jost, C., Roncoli, M.C., Kirshen, P., Hoogenboom, G., Ouattara, F., Sanon, M. 2004. Incorporation of Seasonal Climate Forecasts into Decision Making by Pastoralists in Burkina Faso – Findings from the Climate Forecasting for Agricultural Resources Project. Vetérinaires Sans Frontières Europa Symposium, Belgium, April 15, 2005.

Roncoli, C., C. Jost, G. Hoogenboom, P. Kirshen. 2005. Risk Management and Social Learning in Farmers' Responses to Seasonal Climate Forecasts in Three Agro-Ecological Zones of Burkina Faso. Paper presented at the Annual Meeting of the American Association of Geographers, Denver, CO, April 5 -8, 2005.

Kirshen, P., Rader, M., Hoogenboom, G., Jost, C., Roncoli, C. 2005. Decision Support Computer Tools to Improve Communication of Climate Forecast Information to Farmers in Burkina Faso. Paper presented at Climate Prediction Applications Science Workshop, International Research Institute for Climate Prediction, New York, March, 15-17, 2005.

Kirshen, P., K. Ingram, G. Hoogenboom, C. Jost, C. Roncoli, M. Ruth, K. Knee. 2003. Implementation of Seasonal Climate Forecasting in West Africa. Paper presented at a Workshop on Insights and Tools for Adaptation: Learning from Climate Variability, 18-November 18-20, 2003, Washington, DC.

Kirshen, P., C. Roncoli, C. Jost, K. Ingram, G. Hoogenboom. 2003. Taking Stock and Moving Forward; the Role of Seasonal Forecasting in Adaptation to Long-Term Climate Change, What the CFAR Project in Burkina Faso Has Learned. Paper presented at a Meeting of the International Human Dimensions Program, Montreal Canada, October, 15-18, 2003.

Roncoli, C., K. Ingram, C. Jost, P. Kirshen. 2003. Meteorological Meanings: Farmers' Interpretations and Applications of Seasonal Rainfall Forecasts in Burkina Faso. African Studies Lecture Series, University of Georgia, September 18, 2003.

Roncoli, C., G. Hoogenboom, K. Ingram, C. Jost, P. Kirshen. 2002 Scientific Discourse and Social Meanings in the Dissemination of Seasonal Rainfall Forecasts in the Sudan-Sahel Region of West Africa. Paper presented the Conference on the Human Dimensions of Global Environmental Change, Berlin, Germany, December 6-7, 2002.

Roncoli, C., K. Ingram., P. Kirshen, C. Jost. 2002. Packaging Predictions: Experiences in the Communication of Climate Information to Farmers of Burkina Faso. Paper presented at the Meeting of the African Studies Association, Washington, DC, December 5-9, 2002.

Roncoli, C., K. Ingram., P. Kirshen, C. Jost. 2002. Farmers' Behavioral Responses to Seasonal Rainfall Forecasts in the Sudan-Sahel Region of West Africa. Paper presented

at the 17th Symposium of the International Farming Systems Association, Orlando, FL, November 17-20, 2002.

Roncoli, C., K. Ingram., P. Kirshen, C. Jost, G. Hoogemboom. 2002. Salience and Meaning in Knowledge Encounters: Anthropological Perspectives on Eliciting Users' Needs. Paper presented at NOAA-Office for Global Program's Principal Investigators' Meeting, Seabrook Island, SC, October 22 -25, 2002.

Roncoli, C. and T. Finan. 2002. Livelihood Vulnerability, Climate Applications, and Public Policy: Anthropological Contributions to a Conceptual Framework. Paper presented at a Conference on Environment, Sustainability, and Public Policy, Athens, GA, September 7-8, 2002.

D. Discussion of any significant deviations from proposed workplan

1. Stratified site selection: We originally intended to have three villages in each zones representing different levels and types of forecast-related information and support. In order to do this we selected two villages (representing Level 2 and 3) in each site which had participated in CFAR activities during the project first phase, and added a third village (representing Level 1) where we had not worked before and which was to receive minimal intervention. However, during the second year of research and after consultation with local communities, it became clear that it would be socially and ethically problematic to exclude the village from participating in the workshops and receiving the information that other villages had found beneficial.

2. Forecast dissemination mechanisms: Since the country does not have an official policy of disseminating seasonal rainfall forecast to the broader public, the national meteorological service only allowed us to broadcast forecasts on local level FM stations, which have relatively limited coverage. The role of the extension service was also more limited than initially expected due to several factors: a) decreasing level of resources available to extension services (in response to the conditionalities of national economic recovery programs), b) high staff turnover (which meant that agents that were trained during the 2002 workshop were shortly thereafter assigned to other zones), c) language problems (given regional imbalances in educational opportunities, extension agents often, belong to different ethnic groups than the communities to which they are assigned). We decided against providing additional resources to extension to operate in the CFAR villages because the approach would not be sustainable in the long run. We therefore shifted our focus from extension workers to 'lead farmers' as the key intermediaries in our research design.

3. Decision support system: The actual implementation of the crop simulation models for yield forecasting was not implemented. The evaluation of the crop simulation models for local conditions took more resources than was originally anticipated. In addition, the climate forecasts that were used in this study were qualitative, while the crop simulation models require quantitative information in the form of daily weather data.

E. Where appropriate, describe the climate information products and forecasts considered in your project (both NOAA and non-NOAA); identify any specific feedback on the NOAA products that might be helpful for improvement.

- The project used seasonal rainfall forecasts supplied by the DMN. Some of the forecasters have been trained by the NOAA Africa Desk and the forecast was adjusted based upon the PRESAO climate outlook forums, in which NOAA participates.
- Farmers have repeatedly emphasized that they need forecasts well in advance of the rainy season (at least 3-4 weeks) to make preparations. They also need forecasts of the start and end of rains and wet and dry spells during the season: it is advisable to direct research to those parameters.

III. GRAPHICS: PLEASE INCLUDE THE FOLLOWING GRAPHICS AS ATTACHMENTS TO YOUR REPORT

A. One Power point slide depicting the overall project framework/approach/results to date
B. If appropriate, additional graphic(s) or presentation(s) depicting any key research results thus far
C. Photographs (if easy to obtain) from fieldwork to depict study information (if applicable).

CDs of photographs from fieldwork have been provided in previous years (we can provide them again if needed).

A CD with complete CFAR stakeholder workshop proceedings and a CD of TV coverage of the workshop are also being provided.

IV. WEBSITE ADDRESS FOR FURTHER INFORMATION (IF APPLICABLE)

http://www.ogp.noaa.gov/mpe/csi/econhd/2002/kirshen/index.html (this needs to be updated).

A website for the CFAR project is being created at the University of Georgia, Department of Biological and Agricultural Engineering (projected completion September 2007).

V. ADDITIONAL RELEVANT INFORMATION NOT COVERED UNDER THE ABOVE CATEGORIES.

End-of-Project Stakeholder workshop: In collaboration with the Direction de la Météorologie (DM) of Burkina Faso, and the Institut de l'Environnement et des Recherches Agricoles (INERA) and the RAdio and InterNET Technology for Rural Communities (RANET), the CFAR project organized a Stakeholder Workshop on Communication of Climate Information to Rural Communities in West Africa, in Ouagadougou, Burkina Faso, on June 12 and 13, 2007. The workshop intended to draw on these and similar experiences to bring together lessons learned, and new ideas and to define future directions for research and application of climate information in Burkina Faso and in the sub-region.

The workshop brought together about 98 participants from all the regions of Burkina Faso and countries in the sub-region, including 3 CFAR scientists from the United States, 4 RANET delegates (Niger, Cameroun, Senegal, and Guinée-Conakry), and representatives of 5 regional institutions (ACMAD, AGHRYMET, ASECNA, FEWS, CILSS). A large diversity of

stakeholders were represented: 4 U.S. and Burkinabé universities, 4 research and scientific centers, 2 United Nations organizations (FAO, Humanitarian Affairs), 5 international NGOs, 6 national NGOs and civil society groups, 2 agribusinesses, 4 producer federations, 3 community associations, 6 community or private radios, 4 national media channels (TV, radios, newspaper), 10 government agencies and technical services (agriculture, livestock, environment, water, energy, statistics, etc.). Participants also included 4 CFAR local facilitators and 14 producers, including 3 women. They represented the three agro-climatic zones of Burkina and a wide range of sectors, such as cotton, cereals, legumes, livestock, and vegetable production. Most of the producers came from the CFAR research sites and had experience receiving and using climate forecasts for several years. With the assistance of the CFAR facilitators, who translated between French and the local languages (Moré, Fulfulde, and Dioula), the producers took active part in the workshop debates. They contributed their experience and knowledge of agriculture and, sometimes, even challenged the scientists and decision makers to better address to their needs for climate information and for technical and material support.

The workshop program was made up of presentations, followed by question and answer sessions, working group discussions, and plenary discussions. Guidelines for Presenters had been issued to ensure overall integration and coordination. Presentations focused on 1) the science of seasonal rainfall forecasting in West Africa (including the newly produced forecast for the 2007 rainy season); 2) the CFAR research findings on communication and utilization of climate forecasts by producers of 3 agro-ecological zones of Burkina Faso; 3) the CFAR experience of integrating climate forecasts with crop modeling, with an example of a fully operational system from the Southeast U.S.; 4) the RANET approach and case studies from selected West African countries; 5) the SOFITEX experience of applying climate forecasts to cotton production; 6) the AGHRYMET experience with decision support tools for agriculture and food security; 7) the CEDRES approach to participatory communication for development; 8) one producer's testimony on their participation in the CFAR project and their experience with learning to use climate forecasts.

Active Question and Answer sessions followed each presentation. Many participants offered valuable comments and raised important questions. Interventions focused on a range of issues and challenges, including: 1) how to bridge the gap between farmers' information needs and what the science has to offer; 2) how to translate forecasts in clear messages understandable by users; 3) how to integrate scientific forecasts with traditional knowledge; 4) how to mobilize traditional means of communication, farmers organizations, and Rural Communes in the dissemination of climate forecasts; 5) how climate change affects the reliability of climate forecasts; 6) what is the relationship between climate forecasting and the government's cloud seeding program; g) how to harness the potential of crop modeling, given the latter' high data requirements. Participants complimented the project CFAR for its commitment to building capacity at the institutional and community level in Burkina Faso.

During the second day of the workshop, participants were divided into 3 working groups. Their composition sought to ensured that different sectors and stakeholders be included in each group. Groups were guided by Terms of References, that included questions to be addressed in light of the lessons and findings presented during the workshop. Participants were asked to identify the best strategies and the most suitable structures to ensure that climate information reaches users in timely fashion, in the appropriate language, and with the needed supports to facilitate its understanding and use. The output from the 3 working groups was presented and discussed in the plenary and, then, integrated into the Synthesis Report and Recommendations.

The latter emphasizes the need for: 1) scaling up the pilot experiences of the CFAR and RANET project to the entire country, 2) integrating scientific climate forecasts with farmers' knowledge and experience, 3) developing appropriate (local) language messages and mechanisms to reach rural communities, 4) reinforcing capacities to produce climate forecasts and communicate them to producers, 5) expanding the network of community radios; and 5) disseminating the workshop results through producer and community organizations.